Weatherwise

Volume 11, Number 4 August 1958

"SOME PEOPLE ARE WEATHERWISE BUT MOST ARE OTHERWISE"—BENJAMIN FRANKLIN

WEATHERWISE

THE MAGAZINE ABOUT WEATHER

DAVID M. LUDLUM, *Editor* HENRY W. BULKLEY, *Associate Editor*

IGY Meteorology in Antarctica

THE leading article of this *Weatherwise* describes the International Geophysical Year meteorological program at the Little America station. This historic site, first occupied by Roald Amundsen in 1911, and by Richard E. Byrd in 1928 and 1934, has been the scene of much meteorological activity and discovery. William C. Haines and Henry T. Harrison, Weather Bureau meteorologists, participated in the 1928 expedition, and Haines and George Grimminger were in the 1934 expedition. The valuable surface and upper-air observations, published as *Monthly Weather Review Supplements Nos. 41 and 42*, did much to reawaken interest in the meteorology of this five million square mile block of ice.

During the U.S. Antarctic Service Expedition of 1939–41, Arnold Court, the meteorologist, took the first successful radiosondes in the Antarctic winter, made radiation measurements, and obtained air samples for composition studies. These studies were published in *Monthly Weather Review, Sup. No. 48.*

The site was again occupied in December 1955 in preparation for the U.S.-IGY Antarctic Program. U.S. Navy aerologists maintained the surface and upper-air observations until replaced by IGY observers in January 1957. Ben Harlin, author of the article, was

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Front Cover: An Antarctic twilight silhouettes the U.S.-IGY Byrd Station at 80° South. Weather instruments and aurora tower in foreground. Photo by U. S. Army—SPIRE, Wm. B. Marshall.

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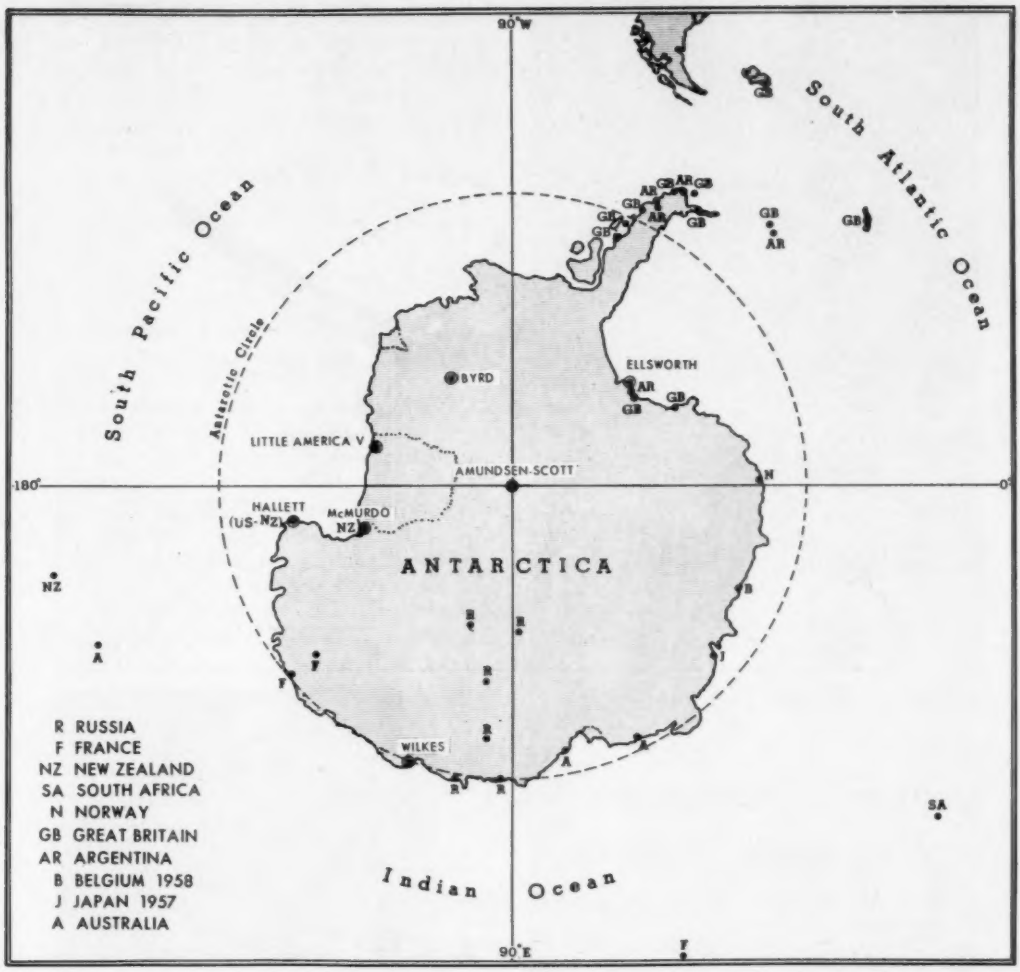
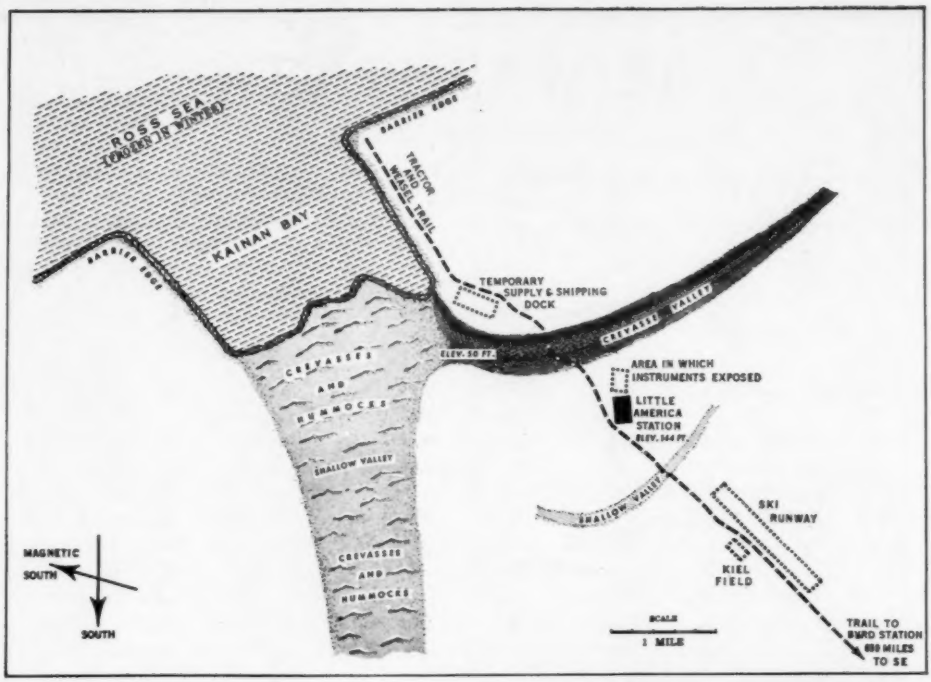


chief meteorologist at Little America and also senior meteorologist for all six of the U.S.-IGY Antarctic stations during 1957.

The U.S. program in Antarctica is part of a coordinated effort carried out by twelve nations at nearly fifty stations located on the continent and islands. Synoptic analyses of the surface and upper-air, made possible by the expanded network, have revealed many unexpected features of Antarctic meteorology.

Subsequent articles of this series will describe meteorological programs at the other U.S.-IGY Antarctic Stations: Amundsen-Scott (South Pole), Byrd, Ellsworth, Hallett (jointly with New Zealand), and Wilkes. Each of these stations filled an important gap in the IGY Antarctic network, each presented different sets of problems, but each was manned by devoted observers who, in the finest tradition of polar meteorologists, successfully carried out their exacting duties under difficult conditions. To these observers, and to their project leader in Washington, Paul A. Humphrey, thanks are due for a job well done.

HARRY WEXLER
Chief Scientist
U.S.-IGY Antarctic Program
National Academy of Sciences



LITTLE AMERICA STATION 1957

Inside Antarctica—No. 1
Little America

BEN W. HARLIN, *U. S. Weather Bureau*

THE USNC-IGY meteorological observation program at Little America Station, Antarctica, began on 30 January 1957, a few hours after the observing personnel had been flown in by helicopter from the *USS Curtiss* in Kainan Bay. The *Curtiss,* a Navy seaplane tender, sailed from San Diego, California, on 29 December 1956, reaching Kainan Bay by way of Port Lyttleton, New Zealand, and McMurdo Sound. Little America Station is located about two and one-half miles south of Kainan Bay on the Ross Ice Shelf at latitude 78° 11′ South and longitude 162° 10′ West.

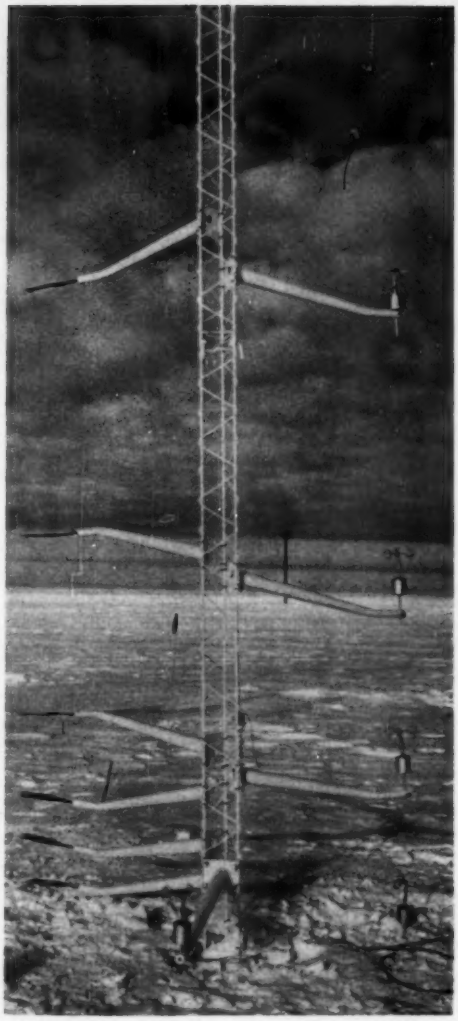
Most of the equipment and supplies had arrived by ship the previous summer. Additional supplies were sent down during the summer of 1956–57, but many last minute items were brought on the *Curtiss,* the last ship to depart from the United States for Antarctica during the summer of 1956–57. The basic weather observational equipment had been set up the previous summer and operated by two Navy aerologists and an IGY electronics technician. One rawinsonde run and a limited number of surface observations had been taken daily. Although these men departed at about the same time as the arrival of the new personnel, the observational program continued without a break.

With the arrival of new men and equipment the observational program was expanded and by March 1st the following instruments required for complete daily and monthly weather summaries were in operation:

GMD-1A rawinsonde equipment (used the previous winter)
Mercurial barometers (land station type)
Microbarograph
Aneroid altimeter
Aneroid barometer
Instrument shelter (mercurial and toluol thermometers)
Thermograph (shelter mounted)
Wind recording equipment
Sunshine duration switch
Precipitation gages
Snow stakes
Ceiling light projector (used previous winter)

Special equipment installed during February included an atmospheric dust sampler and a snow catcher for obtaining newly-fallen snow for chemical analysis. During March the remote reading radiation equipment, the temperature gradient measuring instruments, and the new wind system were installed in an area from 300 to 350 feet north-northeast of the meteorology building. The radiation equipment consisted of: a net and hemispherical radiometer, an upfacing and downfacing pyrheliometer, and a normal incidence pyrheliometer. The temperature gradient equipment included a 50-foot tower with three thermohms: one at 50, one at 30, and one at 5 feet heights; a thermohm on the snow surface; and two thermohms below the snow surface, one at 3 and one at 6½ feet (these heights or depths changed from time to time due to snow accumulations).

The sunshine switch was mounted on the tower to get it above obstructions which might cast shadows. There were two sets of wind equipment mounted on the 10-meter tower. A windmill-type (Aerovane) recorded instantaneous values of wind direction and speed, and a standard 3-cup anemometer and wind vane transmitted to a triple register. Also during March the infra-red hygrometer and the ozone analyzer were installed inside the meteorology building with the air intakes being run up through the roof of the building. Both pieces of equipment gave continuous readings of data near the surface. The infra-red hygrometer is ideal for measuring the amount of water vapor in the air in places such as Little America where very low temperatures are encountered. Total ozone measurements were made with a Dobson spectrometer located in the aurora tower where the observations were taken through an opening in the roof.



The micrometeorology tower—anemometers at right provide wind profiles, while thermocouples at left reveal temperature gradient. NAS-IGY photo by Herfried Hoinkes.

The carbon dioxide analyzer, being rather bulky and complicated, was the last piece of

Little America Station with snow two to six feet deep over the center of camp. Rawin dome and shielded rain gage in left center. Wind instruments atop 30-foot tower at center bottom. NAS-IGY photo by Ben W. Harlin.

equipment to be set up, installation being completed in April. Local sources of carbon dioxide made it necessary to extend intake lines a considerable distance from camp in the direction from which the wind blows most frequently to get uncontaminated air for analysis. The first intake line ran approximately 950 feet to the north-northeast. Near the camp it was buried under the snow for protection from vehicular traffic with the remainder being laid on the snow surface. The unburied portion soon became covered with snow. During warm humid weather frost would form on the inside of this line stopping

Latitude 78° 11′ South
Longitude 162° 10′ West
Barometer elevation 144.2 ft.

METEOROLOGICAL DATA

Month	Temperature							Degree days	Precipitation					
	Averages			Extremes								Snow, Sleet		
	Daily maximum	Daily minimum	Monthly	Highest	Date	Lowest	Date		Total	Greatest in 24 hrs.	Date	Total *	Greatest in 24 hrs.	Date
J														
F	18.9	1.6	10.3	30	6	-17	19	1529	0.67	0.53	23	9.5	6.0	23
M	- 4.3	-25.1	-14.7	15	4#	-49	31	2479	0.66	0.25	27	5.6	1.7	27
A	-16.6	-37.4	-27.0	10	10	-55	27	2673	0.36	0.13	9	3.6	1.3	9
M	-12.7	-34.0	-23.4	30	11	-63	24	2756	2.31	0.86	8-9	22.1	7.6	8-9
J	- 1.9	-20.2	-11.1	25	15	-51	10	2285	1.50	0.40	16	15.6	4.0	16
J	-23.0	-40.9	-32.0	6	24	-61	10	3005	0.37	0.12	20-21	3.7	1.2	20-21
A	-20.0	-40.2	-30.1	0	29	-56	2&26	2954	0.19	0.06	29	2.2	0.6	29
S	-19.0	-39.5	-29.3	- 3	14	-51	13	2842	0.32	0.07	4-5	2.8	0.7	4-5
O	6.2	-12.6	- 3.2	29	27	-43	1	2117	1.28	0.31	5-6	13.6	3.7	5-6
N	16.7	2.1	9.4	30	30	-16	14	1661	0.58	0.27	1-2	5.5	2.8	1-2
D														

* It is believed that these readings are too high, especially so for the snow accumulations during the blizzards of May and June, because measurements were made too near the camp. Readings from snow stakes (see table 3) shows no accumulation for May and only 0.8 inches for June as compared with 22.1 inches for May and 15.6 inches for June as shown in this table.

the flow of air. It was later replaced by shorter lines mounted up above the snow surface so that they could be taken down for cleaning if necessary.

February in Little America was comparatively mild, making it not too unpleasant to work outside during most of the month. Temperatures fell rapidly though during March and April, and the average monthly temperature for April was − 27° F. A warming trend followed during May and June with the average for June rising to − 11.1° F. The highest and the lowest temperature of the four-month-long winter night occurred in May. The highest, + 30° F., occurred on 11 May during one of the worst blizzards of winter and the lowest, − 63° F., was reached on 24 May. It became colder again in July with the average for the month being − 32° F., the coldest for the winter. August and September remained cold with only a slight rising trend—not until October did rapid warming begin.

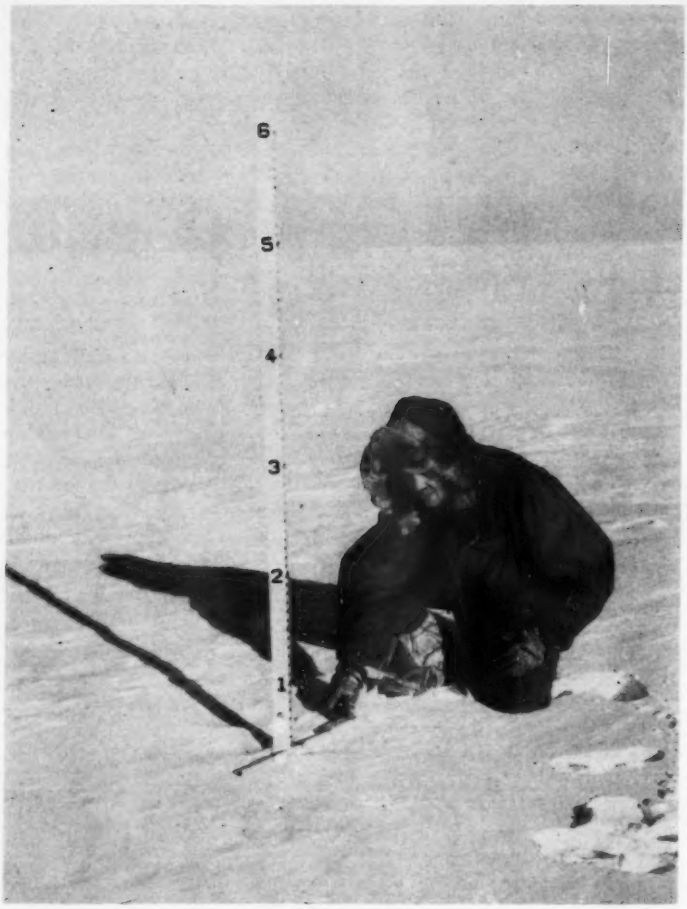
The worst blizzards occurred during the months of May, June, July, and August, with the most prolonged one taking place in May. The strongest blizzard winds struck near the end of August with 75 mph recorded on the 30th. The May blizzard began on the 8th and except for a few short lulls continued until the 15th. The temperature read − 48° F. on the first day and the wind blew from the south-east, continuing from that quadrant almost steadily until the 11th when it shifted to the north-northeast and increased in speed. The air then became much warmer and more humid with the temperature rising to + 30° F. for a short time. The blizzard caused heavy drifting of snow in the camp area so that one could walk up and down along either side of the main tunnel leading through the camp without being able to detect the buildings except for the smokestacks sticking up through the snow. Some of our supplies were covered up during this blizzard. It was necessary to dig them out and cache them in more favorable locations so that they would not be lost again. Snow had drifted up almost level with the floor of the instrument shelter and it had to be dug out and relocated. Most other outside instrumentation required attention also.

FOR THE CURRENT YEAR

Little America Station
Antarctica 1957

Wind					Percent of possible sunshine	Average sky cover sunrise to sunset	Number of days										
		Fastest mile					Sunrise to sunset			Precipitation .01 inch or more	Snow, Sleet, 1.0 or more	Thunderstorms	Heavy fog	Max. temp.		Min. temp.	
Average hourly speed	Prevailing direction	Speed	Direction	Date			Clear	Partly cloudy	Cloudy					90° and above	32° and below	32° and below	Zero and below
9.3	SE	--	--	--	--	7.9	1	11	16	6	2						
13.5	SE	35	SE	21	36	7.0	4	8	19	11	2						
11.7	S	42	N	10	22	6.0	10	7	13	4	2						
15.9	SE	61	NE	14	**	5.1	15	0	16	12	8						
17.3	SE	54	NE	13&14	--	7.2	5	8	17	13	6						
14.5	SE	39	NE	24	--	5.3	10	10	11	7	1						
16.2	SE	75	N	30	25	6.0	9	14	8	5	0						
12.0	SE	25	NE	14	47	6.0	7	13	10	8	0						
17.6	SE	52	NE	7	30	8.0	2	9	20	13	7						
11.1	SE	39	N	1	43	7.0	8	5	17	6	2						

** Last day of sunshine before winter night April 23, first day of sunshine after winter night Aug. 22.
# Also on 20th and 21st.



The author is making measurements on snow stakes which are six feet high. NAS-IGY photo.

Before winter was over the camp was covered in places six feet deep and there were only a few buildings which did not get completely covered. As a precautionary measure to secure adequate ventilation, the Navy personnel installed several ventilators along the main tunnel of the camp. The ventilators were made by cutting the ends from barrels and then welding two or three together. Although the snowdrift accumulated quite rapidly in the vicinity of the camp during blizzards, the accumulation in level unobstructed areas, a mile or more from camp, was probably not more than 10 to 15 inches during the year. The greatest snowfall not associated with blizzards occurred during February and again in October. This snow was of lower density and being softer was much more difficult to walk on than the hard packed snow which accumulated during blizzards. Snowshoes or skis were very helpful in walking and were almost a necessity if the distances to be traveled were very far.

The accumulation of 22.1 inches of snow for May and 15.6 inches for June (see table 1) is probably not representative because measurements were made too near the camp. The data from snow stakes show much less accumulation for these months (see table 3). With the rapid build-up of snow during February it was thought that the annual cover would be quite deep and a special effort was made to get four snow stakes set up on March 1st so as to have records from the

TABLE 2

BAROMETRIC PRESSURE IN INCHES

Month	Monthly average station pressure	Highest sea-level and date		Lowest sea-level and date	
February	28.950	29.53	18th	28.58	3rd
March	28.760	29.67	20th	27.93	26th
April	28.980	29.98	28th	28.46	18th
May	**29.120**	30.18	26th	28.47	19th
June	29.075	**30.41**	10th	28.23	19th
July	28.760	29.55	7th	28.28	22nd
August	28.840	29.78	24th	**27.50**	29th
September	28.620	29.28	27th	28.22	20th
October	28.825	29.65	18th	28.22	8th
November	28.868	29.53	30th	28.22	2nd

beginning of the month. Instead of the continued rapid pile-up, as had been the case in February, a strong southwesterly wind came up on March 2d and after several hours almost 6 inches of snow had been eroded from the surface and blown away leaving the surface very hard and rough. Where the snow had been made compact by people walking or vehicles passing over, it was left several inches above the rest of the surface. The

TABLE 3

SNOW STAKE READINGS

Date 1957	Stake No. 1	Stake No. 2	Stake No. 3	Stake No. 4	Average net accumulation between readings
March 1	0	0	0	0	0
March 3	− 6 in.	−6 in.	−4.5 in.	−6 in.	−5.6 in.
March 30	− 3 in.	−2 in.	−1 in.	−5 in.	+2.9 in.
April 2	− 4 in.	−3 in.	−2 in.	−6 in.	−1.0 in.
May 2	− 3 in.	−2 in.	−1 in.	−5 in.	+1.0 in.
May 31	− 4 in.	+1 in.	−2 in.	−6 in.	0.0 in.
July 1	− 1 in.	+1 in.	−2 in.	−6 in.	+0.8 in.
August 1	+ 2 in.	+1 in.	0	−4 in.	+1.8 in.
August 31	+ 1 in.	+1 in.	0	−5 in.	−0.5 in.
September 30	+ 1 in.	+1 in.	0	−5 in.	0.0 in.
November 1	+12 in.	+7 in.	+2 in.	−2 in.	+5.5 in.
November 30	+14 in.	+6 in.	+3 in.	0	+1.0 in.
					Total +5.9 in.

The first snow stake was located approximately 500 feet north of the meteorology building and the other three were located in a straight line running north-northeast from the first, the second being 250 yards from the first, the third 220 yards from the second and the fourth 200 yards from the third. The first three stakes were on an almost level plane while the fourth was on the southern slope of a crevasse valley. The effect of nearness to the camp can be seen on the first two.

TABLE 4

DENSITY OF NEWLY FALLEN SNOW OR SNOWDRIFT

Date 1957	Length of core in inches	Density	Wind range or velocity during estimated period of accumulation
June 2	12.0	.208	Not determined
June 12	6.5	.077	
June 12	15.5	.178	
July 14	10.0	.269	18–29 Knot range
July 24	12.0 (Avg. of 2 samples)	.329	25–35
July 30	13.5 (Avg. of 2 samples)	.237	15–25
Aug. 1	24.0	.282	23–30
Aug. 15	9.0	.145	12–21
Aug. 31	24.0 (Avg. of 3 samples)	.437	45 Knot average
Oct. 8	24.0 (Avg. of 2 samples)	.344	32
Oct. 23	7.4 (Avg. of 3 samples)	.181	19
Nov. 1	24.0	.263	23
Nov. 2	17.0	.320	Not determined

Due to the small accumulations of snow on a level plane most samples were taken on the leeward side of objects where a sufficient depth of snow would accumulate to measure.

snow had even been eroded from under some of the tracks leaving them supported by an arm 15 or 20 inches long from the snow surface. As the arms grew to a critical length they could no longer support themselves and would bend under the weight of the snow, letting the ends touch the surface. The accumulations during the blizzard months were rather light and it was not until October that the level of the snow surface as shown by the snow stakes reached what it had been on March 1st.

September had mostly fair and cold conditions, but there was much cloudiness and frequent snowfalls during October and the first few days of November which restricted flight activities and other outside operations. After the first few days in November, though, conditions improved and there were many sunny days during the remainder of the month.

During June some density measurements of newly-fallen snow or snowdrift were begun and measurements were continued until the first part of November when no more accumulations occurred deep enough to measure (see table 4). It had been observed during February that the snow cover had been of a rather low density and difficult to walk on, but it was not until after a number of density measurements had been made that it was realized that there might be some correlation between the snow density and the speed of the wind while the snow was accumulating. Afterwards when making density measurements, an attempt was made to get the range of wind speeds or the average wind speed during the period that the snow was accumulating. This is rather difficult to do since drifts shift around from time to time and it is difficult to determine when a particular drift started to build up. From the few readings made it appeared that densities ranged from about 0.1 or less with very light winds, or winds not over 10 knots, and increased about 0.1 for each 10 knots increase in wind speed up to about 40 or 50 knots. Not enough readings were made to determine precisely what this relationship might be, or if the temperature might have some effect on the density also.

Frost formation at Little America was very heavy at times especially during the fall and early spring. Feathery hoar frost an inch or more thick would occasionally form on the exposed equipment. Under these conditions it was necessary to remove the frost from the radiation equipment every few hours. At

times some of the observations from the radiometers were affected by the frost. Under average conditions frost would not readily form on the radiometer plates since air was blown over them from their ventilating fans. Usually it was necessary to clean frost from the pyrheliometers about twice daily. Heavy deposits of frost would form on the moving parts of the wind equipment which had to be removed to reduce errors in the wind speed indications. During periods of high outgoing radiation the temperature on the snow surface would occasionally be 20 to 30 degrees F. colder than at 50 feet. At one time a small vertical difference of 34 degrees was noted.

The winter spent at Little America proved an interesting one. Conditions turned out better than had been expected. The hours of work were long, and there never seemed to be time enough to get all the things done, but this only made the time pass more swiftly. Blizzards are the most unpleasant things about the Antarctic. They come up unexpectedly and then go on for days and days until it seems that they will never end. It is almost impossible to do anything outdoors while they continue, and they cover up exposed instruments, buildings, and supplies. The cold caused some frostbites, but none of the meteorological personnel suffered any serious cases. Living conditions and food were good. Entertainment was adequate for the average person who had plenty of work to do. You heard none of the weathermen say that they were sorry that they chose to spend a year at Little America, but all were glad to leave when the opportunity came. The replacements arrived on November 30th and after a few days of training they were ready to take over. Most of the men who had wintered at Little America were able to get air transportation back to the United States early in December and arrived home in time for a wintry Christmas.

Rough snow surface after about six inches of snow had been eroded by a strong southwest wind during early March 1957. Photo by Ben W. Harlin.

USNS *General Edwin D. Patrick*, one of the five ships which make regular surface and upper-air observations in the Pacific Ocean. Department of the Navy photo.

The U. S. Weather Bureau Transient Ship Upper-Air Program

WILLARD W. SHINNERS

Chief, Marine Observations Unit, U. S. Weather Bureau

THE Ocean Station Vessel program was reduced following World War II as the military requirements diminished. However, the great synoptic value of the upper-air observations that were made from the ocean station vessels was recognized and other means were sought for increasing the amount of upper-air information over the ocean areas. One of several plans proposed was that of making radiosonde releases from merchant vessels during regular ocean crossings. Discussions led to an initial test of the plan on the USNS *General Callan* during the period 16 September–17 October 1950.

The *Callan* is a C-4 troop transport of 12,000 gross tons, 522 feet in length, and a beam of 72 feet. A few minor modifications were made to the vessel for the purpose of conducting twice-daily radiosonde observations during the voyage between New York and Mediterranean ports. A tent was rigged over a portion of an empty gun tub aft, pad eyes were welded to a nearby bulkhead to secure the helium cylinders, and the recorder rack was welded to the cabin deck located just below the inflation area. Two Weather Bureau radiosonde specialists, V. D. Rockney and G. L. Poole, made 17 upper-air soundings during the voyage. The inflation of the balloon and release of the radiosonde train was made without interference in routine ship operations. This was accomplished using 500-gram balloons and with apparent surface winds up to 40 knots. Equipment used for the test was similar to that used on the ocean station vessels, which included the 72.2-Mc. radiosonde and Cycloray recorder. The average height reached by the flights was 20,192 meters, with one flight reaching 29,371 meters. Analysis of data indicated that successful upper-air observations could be made from moving ships by two experienced observers.

In order to test the idea further under more severe operating conditions, a second program was conducted aboard the USNS *General Rose* on a roundtrip voyage between New York and Bremerhaven beginning in March 1951. For inflation of balloons, a custom-made canvas shelter was secured on the port side aft. During the voyage, 31 successful radiosonde observations were made, with

several of the releases being accomplished with apparent winds of 40 to 50 knots. Results of the test were quite good. Forecast offices receiving the data commented favorably on the accuracy and utility of the observations. The maximum height reached was 30,565 meters, with an average height for the 31 soundings being 20,776 meters.

At times, some slight interference was caused by the ship's radio, but at no time was it sufficient to cause termination of a flight. Other difficulties peculiar to shipboard were encountered; for example, during heavy weather the observational quarters aft were subject to severe vibrations whenever the screw broke water. Also, the large vertical motion as the ship pitched caused difficulties in making releases and working at the recorder.

Based on experience gained in the two trial voyages, plans were developed for a full year or more of testing and evaluation of upper-air soundings from transient ships. The USNS *General Hugh J. Gaffey* operating between the United States west coast and Japan was selected. Two Weather Bureau employees were assigned to the vessel to make two soundings per day using Vaisala equipment. The Finnish-built equipment was used because of its light weight, permitting the use of 100-gram balloons inflated to give a lift of 700 to 800 grams. Flights averaged 10,700 meters, with only three soundings missed during 240 days at sea.

The *Gaffey* program started on 18 February 1955. In September and October of 1955, similar programs were established aboard two freighters, the SS *Emilia* and SS *Jean*, operated by the A. H. Bull Lines between Philadelphia, Baltimore, and Puerto Rico. Two cabin spaces were modified slightly to provide working and sleeping facilities for the two observers. A metal inflation shelter was installed aft of number 5 hatch and a rack for cylinders of helium was rigged adjacent to the shelter.

A further expansion of the program followed on 5 January 1956, when radiosonde observations were started on the SS *Carl Schmedeman*, a bauxite ore carrier operating between Jamaica, B.W.I., and Gulf Coast ports. A month later, another ship, the *Salinas*, an oil tanker operating between Tampico, Mexico, and Tampa, Florida, entered the program. In each case, two Weather Bureau observers sailed aboard the vessel, making two upper-air soundings and four synoptic observations daily while at sea.

During 1956 and 1957, radiosonde observations were made for periods of time aboard two oceanographic research vessels. One, the Motor Ship *A. A. Jakkula*, was operated in the Gulf of Mexico by the Texas A. & M. Research Foundation. The other was the Motor Ship *Crawford* operated east of the Lesser Antilles by the Woods Hole Oceanographic Institution.

During the summer and fall of 1956, the Pacific transient ship upper-air program was increased to a total of five vessels, which operated over routes between the United States west coast, Alaska, Korea, Japan, Philippines, and various Pacific Islands.

Instrumentation has undergone changes since the first regular observations on the *Gaffey*. The AN/AMT-11 light weight, 403-Mc., pulse radiosondes carried aloft by 300-gram balloons are being used aboard the MSTS vessels, while a miniaturized 72.2-Mc. radiosonde developed by the U. S. Weather

(*Continued on page 139*)

A Weather Bureau observer releases a Vaisala-type radiosonde from the SS *Jean*.

Weather Rambles

IVAN W. BRUNK, *U. S. Weather Bureau, Chicago, Ill.*

NEW METEOROLOGY TEXTBOOK

It is refreshing to read a book about the weather which is not as difficult to comprehend as a treatise on theoretical meteorology. A new book just off the press by author and educator, Jene Barr, does an excellent job of presenting various facets of meteorology for the age group for which it is intended. The book is illustrated by CBS-TV weatherman, P. J. Hoff, and is entitled, *Dan the Weatherman*. The jacket of the book states: "Everybody talks about the weather and here Jene Barr does something about it for the youngest readers. The whole range of weather is spread before us in skipping style and easy reading; wind, rain, thunder, and a rainbow lure the reader. Fog and snow, and how the farmer, the truck driver, the pilot, and people in general feel about weather, all have meaning in these pages." *Dan the Weatherman* is published by Albert Whitman and Company, Chicago, Illinois and is priced at $1.25. Other books in the Community Helpers series by Miss Barr include: *Policeman Paul, Fireman Fred,* and *Baker Bill.*

FAREWELL MESSAGE TO THE OFFICE OF U. S. WEATHER BUREAU, CHICAGO, ILLINOIS

"To any of you guys weatherwise:

I have been residing in Chicago for past 18 years. Fifteen years on same job. Recession hasn't hurt me one bit. Now let's get to the moral of the story. I'm a hillbilly by birth, and I hate to admit that Chicago's weather has almost driven me to a psychiatric ward. One day I take off my "longies" and figure maybe this is it. Next day I've got 'em back on again. Every day I have off the job, I can depend on the weather being so lousy I can't get out of the house. Burning oil 9 months out of the year, nothing short of Siberia can beat that. I have finally given up the ghost. Come hell, high water or poverty, I'm selling out, buying a trailer and heading back to the sunlit hills of Tennessee. Brothers I have had it. I sincerely suggest you gentlemen put in for transfer and join me."

(from a post card recently received by the Weather Bureau)

METEOROLOGISTS HAVE THE LAST LAUGH (?)

Chicago, Ill., June 25, 1958—Those who poked fun at, or who may have heard, adverse comments about the scheduling of a picnic of the American Meteorological Society yesterday—on a day when it rained—may also be interested in the complete story. The annual picnic of the Chicago chapter of the American Meteorological Society—an organization composed of meteorologists from a number of organizations—was scheduled months in advance. It is not possible to accurately predict the weather on a specific date more than a few days ahead so the picnic was scheduled without regard to expected weather.

Yesterday forenoon rain was falling and a decision had to be made whether to postpone the picnic or not. After a consultation of meteorologists, it was decided that the rain would end by afternoon, and that there would be considerable sunshine by late afternoon. The weather turned out almost exactly as expected, and a goodly number of meteorologists enjoyed a picnic from 5 to 9 P.M. The temperature was just right not too hot or too cool, and this rather brief interval of good weather

was sandwiched in between rain yesterday forenoon and rain again today. So after all, it was the meteorologists who had the last laugh.

Chicago, Ill., June 26, 1958, from the Chicago *Daily Tribune:* "Weather Men Explain Rain; It's No Picnic. . . ."

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Effect of Deficient Precipitation on Great Lakes Levels

"Rain and snow falling on the drainage basins of all the Great Lakes has been considerably below average during each month since the first of the year except for Lake Ontario during February.

"In view of the greatly decreased supplies of water to the lakes which resulted from this precipitation deficiency the U. S. Lake Survey considers it advisable to point out that the lakes will not reach the levels which they were expected to attain before it could be known that these conditions would continue into the summer. The seasonal rise of the lakes from the winter lows to the summer highs generally occurs from April through July and the amount of the rise is determined largely by rain falling during these months and by water which was stored on the land areas of the basins in the form of ice and snow during the winter period. The amount of rise in lake levels to be expected from rainfall later in the summer is slight since most of rain which falls on the land during early summer is lost through evaporation, use by crops and other vegetation as transpiration, and through other means.

"The accumulated rain and snowfall, starting in October 1957 at the beginning of the water year, was about average by February, having been slightly higher during the earlier months of the period. The downward trend started in January, became more pronounced during February and the succeeding months, and reached a marked deficiency by the end of May."

(From a recent release by the U. S. Army Engineer District, Lake Survey, Detroit, Michigan.)

Wet Forecast

This man who telephoned said, "The government won't fix the roof, and the weather forecasters are sloshing around over there on the top floor of the United States Court House in their stocking feet in several feet of water. This may help as they cannot help but know when it is raining."

Weather Forecaster Ivan W. Brunk said this report was vastly exaggerated. "Remember how it rained on Friday the 13th?" he asked and added, "A rain we predicted by the way. Well it rained so hard that day that some of us took off our shoes, and someone saw us."

"Don't you set much store by your forecasts?"

"Yes," said Mr. Brunk, "but it rained so hard we were soaked anyway."

He said, as a matter of fact, the roof was much better since they fixed it.

"Oh," he said, "there is a little water coming in in a few places."

Take this very day, said the reporter. The forecast said no rain, so he left home his raincoat, and here he was as moist as a resident minnow. How did Mr. Brunk explain that?

"The rain wasn't in yesterday's forecast," said Mr. B., "but it was in today's."

Weather Forecaster Brunk said the weather forecasters have a batting average of 85 per cent, which is better than the Cubs, White Sox, and groundhogs. Forecasters, he said, do not get much more abuse for wrong forecasts than they get thanks for right ones.

Mostly, though, Mr. B. said, it is when a forecast has tossed a protecting arm around a pocketbook that the thank you's arrive. Like a man may say, "The legumes are lush, and appear ready to pay off like three bells on a slot machine—thanks for the forecast."

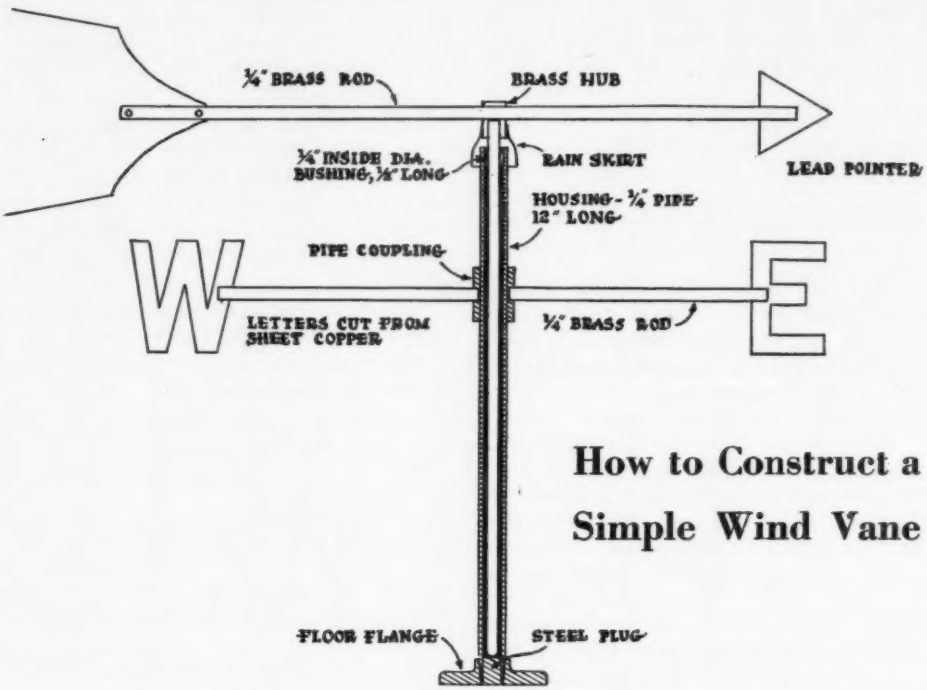
"When you predict fair weather do you come down to work with confidence?"

"Well, no," said Mr. Brunk, lowering his voice a little. "I carry my raincoat in a brief case so no one can see it."

(From the column, "A Line O' Type or Two" from the Chicago *Daily Tribune,* June 20, 1958.)

WORKSHOP FOR WEATHERMEN

CONDUCTED BY CHARLES A. LAIRD



How to Construct a Simple Wind Vane

Mr. Charles A. Laird commences a new series of his popular Workshop for Weathermen. A former U. S. Weather Bureau instrument technician, Mr. Laird now lives at 2530 Cody Street, Bettendorf, Iowa. With his wife, Ruth, he is coauthor of *Weathercasting. A Handbook of Amateur Meteorology.*

THE weather vane is probably the grandaddy of all weather instruments. The one described here, although fairly easy to build, is all-metal, sensitive, and durable. While general construction should be followed carefully, dimensions are flexible.

The upright support, or bearing housing, in this vane consists of a section of ¼" pipe, 12" long, threaded at the lower end. (So-called quarter-inch iron pipe is actually about ⅜" inside diameter.) Solder a plug made of a ½" section of ⅜" drill rod in the lower, threaded end of this 12" pipe section. This acts as a step, or support, for the rotating vane shaft.

Now insert a brass bushing into the upper end of the pipe support. This may be from ½" to 1" in length. Or better still, use a standard bronze bushing, obtainable from bearing supply houses and some hardware stores. The bushing's inside opening should be ¼". You may have to do some filing to get it in the pipe. It should fit tightly.

The upright spindle supporting the vane is a section of ¼" drill rod or steel shafting. It should be long enough to extend about ¾" beyond the pipe support. Round the lower end of this shaft with a file or lathe, then smooth it with crocus-cloth. Weight of the vane is supported by the rounded end of this

steel spindle, resting on the steel plug. This gives almost frictionless operation. Some commercial wind vanes, used by the Weather Bureau and other services, have this type bearing. The ¼" pipe is filled with oil (later) to assure smooth operation.

The horizontal (tail) shaft in the vane shown here is a section of ¼" brass rod, 15" in length. A piece of ¼" inside diameter brass tubing is used to fasten this rod at right angles to the upright vane spindle. It is ¾" in length and about ½" outside. This forms the hub. Drill a ¼" hole at one end of this hub. Through this hole runs the tail shaft.

The pointer, or counterweight, is made of lead. It may be cone-shaped, as shown here. To fashion the pointer, first make a little plaster or sand mold. Then insert one end of the tail shaft in the mold and pour in molten lead. Or the pointer may be shaped from a chunk of lead, using a hack saw, and then soldered onto the tail shaft.

With a hack saw, split the opposite end of the tail shaft about 2". After slipping the tail shaft through the hub, insert the tail into the cut and rivet or fasten with small bolts.

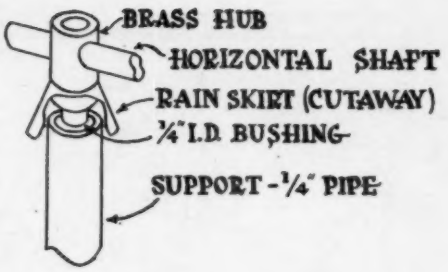
Make the tail from sheet aluminum, cut any shape you desire. Shape of the tail shown here follows generally a style used on some commercial vanes. It is about 9" long and 8" high at its largest dimensions.

Solder the tail shaft into the hub, first pushing the shaft back and forth until a balance point is reached. Weight of the pointer should just counterbalance the weight of the tail.

A small rain skirt, to keep water out of the vane bearing, is soldered to the hub. It may be shaped out of brass or copper. The vane shown here uses a rounded cone made from a brass device used to hold lamp shades on some types of table and floor lamps. Look around in your hardware store. You may find one of these, or something similar, that will do.

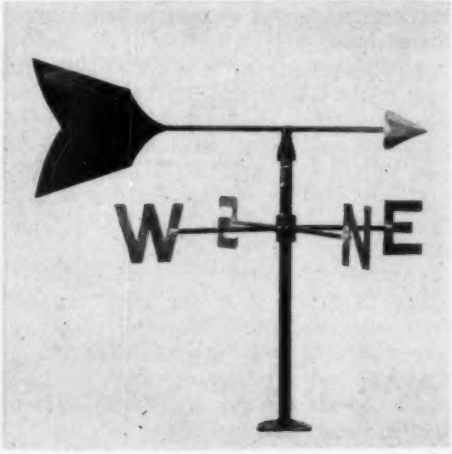
After finding the balance, the whole hub assembly is soldered to the support shaft. Or you may drill and tap and use set-screws if you prefer.

A standard floor flange is employed at the lower end of the ¼" pipe to mount the vane on a roof. Or you may use couplings and mount the vane on a higher mast.

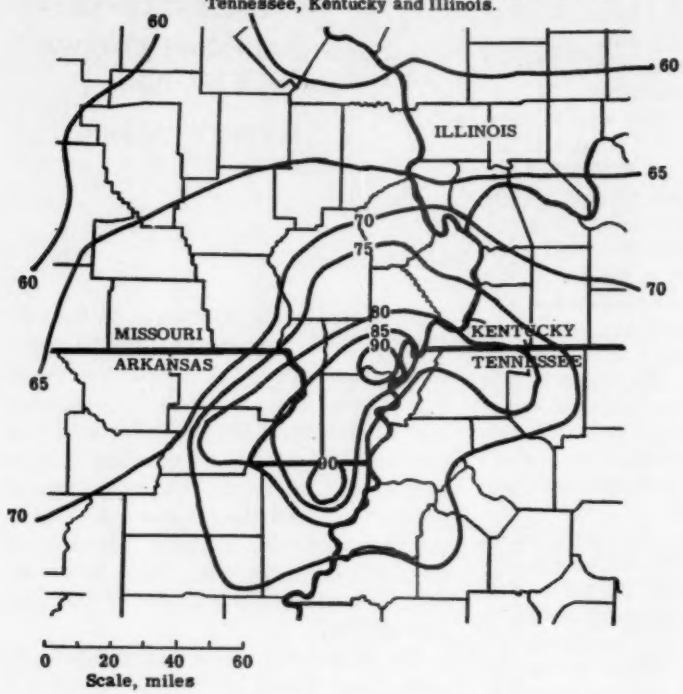


If you care to add direction arms, the style shown here may be followed. The four arms are 5" lengths of ¼" brass rod, inserted 90 degrees apart into a standard ⅜" pipe coupling and soldered. This coupling is slipped over the ¼" vane support pipe and clamped with a 6-32 set-screw. The letters are 3" high and cut from sheet copper. It's best to cut them out with a jigsaw, although tin snips will do a fair job. These letters are inserted into the split ends of the four arms and soldered.

The vane shown here is painted black; the pointer and letters, aluminum. Before putting the vane into use, a little machine oil should be poured into the bearing assembly. The bearing should be cleaned out and re-oiled occasionally.



The geographic distribution of annual precipitation for 1957 in Southeast Missouri and neighboring counties of Arkansas, Tennessee, Kentucky and Illinois.



Swamp Weathe
Southeast M

WAY
Associate Professor of Cl

SOUTHEAST Missouri received disastrously heavy precipitation during 1957. In some parts of this region in excess of 90 inches of water was received during the twelve-month period. The area was one of the highest rainfall regions of the United States during 1957.

The six-county area, which received the bulk of the heavy precipitation, is a distinct physiographic, agricultural, and economic region. It comprises over two million acres of land with little or no slope. This land is difficult to drain and much of it is farmed only because of reclamation of the land by drainage enterprises.

Over seventy per cent of the land is in farms. Virtually all of the farm land is in cash crops with little livestock production. The major crop is cotton with nearly six hundred thousand acres planted each year. Corn and soybean acreage account for the bulk of the remaining farm enterprise.

Because the terrain is very flat, inundation occurs during periods of high rainfall. A typical scene of such an inundation is shown by the aerial photograph in figure 1. That such occurrences can occur during the height of the growing season is demonstrated by the picture in figure 2.

Rainfall was abundant in southeast Missouri throughout 1957. March and September were the only months with subnormal amounts. An area of maximum rainfall was recognizable in this general region on eleven months of the year. The heaviest rainfall occurred in the months of May, June and August.

Weather records have been taken in this area for the past ninety years. The previous high annual totals and the 1957 totals at four locations in the area are shown in table I. Two of these official stations had previous records higher than reported for 1957, but for both of these locations the 1957 total ranked

Weather in the Lowlands of Southeast Missouri in 1957

WAYNE L. DECKER,
Professor of Climatology, University of Missouri

second. It is of further interest that at the University of Missouri Experimental Farm, located one mile south of Sikeston, a total of 83.53 inches of precipitation occurred during the past year. This total exceeds the 1927 total for the official station within the city. It is apparent that 1957 was the wettest of the past ninety years, at many locations in southeast Missouri, and it is probable that it is the wettest of record for the bulk of the six counties in extreme southeast Missouri.

TABLE I

ANNUAL PRECIPITATION

Location	Highest of record	1957 Total
Caruthersville	66.42	76.18
Cairo, Ill.	70.40	72.98
Poplar Bluff	77.76	67.88
Sikeston	80.71	79.61

A Missouri farmer inspects his half-submerged crops.

The geographic distribution of the annual precipitation for 1957 is shown in figure 3. This analysis is based on the available "official" records. There are "unofficial" reports of amounts in excess of 100 inches for the year within the area. These unofficial reports would change the detail of the map to a small extent, but they would not alter the general picture. This map shows two areas with an excess of 90 inches of precipitation for the year. This is equivalent to over 460 pounds or 55 gallons of water on each square foot of area.

Southeast Missouri and the neighboring counties of the adjoining states represent an area receiving more precipitation for 1957 than most other part of the nation. Aside from places in Pacific Northwest, it is doubtful if any other region received amounts in excess of 90 inches of precipitation.

The flooded fields as seen from the air.

Springtime in the Poconos

THE huge drifts which paralyzed the Pocono area of northeastern Pennsylvania on 16 February 1958 remained in view until May 19th.

On April 19th an early cottager to Pocono Peak Lake, out to escape the heat, was surprised to find three feet of snow blocking the road to his cabin.

Ice on the lake survived the heat wave of the third week in April and still remained on the 27th, a record here for so late in the season.

The upper illustration was taken May 1st in the Long Pond area near the Delaware-Lehigh Experimental Forest at Pimple Hill, Pennsylvania, where a total seasonal snowfall of 132 inches was measured. Note the Balsam Fir trees in the foreground with limbs completely stripped and bundled around the base of the trees.

As the crusted snow surface receded from the tree tops during the period of alternate thawing and freezing from February through April, the limbs were stripped progressively downward and ultimately deposited around the trunks of the trees in an orderly fashion.

The lower photo was taken also on May 1st about one-quarter mile from the Long Pond weather station. Thomas Meckes, Jr. is standing on a drift nearly two feet deep blocking a mountain logging road. On May 11th a trace of this snow remained amidst spring blossoms and thriving green leaves.

Snow persisted on the shore of Naomi Lake until May 12th and at Stillwater Lake until May 16th where vegetation was flattened

DIXON R. MILLER,

Hydrologic Observer,

Long Pond, Pa.

from a 15-foot deep cover in February. There the lakeshore road was blocked with snow until May 3rd when a truck for the first time was able to ram through the two feet still remaining on the ground.

In February the deepest observed drift in the Long Pond area was 20 feet deep. On May 13th this massive drift, still two feet deep, covered an area measuring 50 feet by 18 feet. On May 19th at 1300 EST the remains of the above drift were photographed while luxuriant Quaking Aspen in the vicinity displayed a nearly mature mantle of green.

This is the latest record of winter snow remaining in this area and one that may hold for many generations.

Weatherman Sees Twister

"I GUESS the chances of the weatherman seeing a tornado in this New Jersey area are about a million to one," said Trenton's weatherman George Whiteley in speaking of June's Friday-the-13th twister which came within a quarter-mile of his home in Bordentown township.

"We were eating," he said, "and I'd been watching the sky from about 5 o'clock on. It looked like a particularly bad storm, getting blacker and blacker.

"Next thing I knew, there it was—a funnel cloud off to the northwest of here, just across Route 206. It was 5:20.

"The cloud was shaped just like an elephant's trunk or a long cone with the point of the cone on the ground. It stretched from the ground to a height of about 2,000 feet.

Debris Whirling Around

"It was a dense black funnel and one could see all sorts of debris whirling around in it—shingles, boards, dust, slates, pieces of trees.

"As it came closer, my wife and I and the three children went into the cellar. (That's the only thing you can do for protection, get underground. People should keep an eye on black thunder clouds because that's about the only warning you have of a tornado. There was no earlier warning here; it just suddenly formed. The best advice is this: If you see a funnel cloud, get down below.)"

300 Yards from Home

After the cyclone passed, Whiteley inspected the mile-long swath it had made and found it had passed within about 300 yards of his home.

"It moved almost straight west to east," he said, "but it wasn't on the ground all the time.

Winds 200 Miles an Hour

"The winds were whirling at a tremendous rate—certainly in excess of 100 miles-per-hour and possibly as much as 200 or 300 miles per hour. In a wooded section near Groveville it looked as if a giant lawn mower had gone through snapping trees—big trees—right off at the base.

A Real Tornado

"This was a real tornado and it could have killed a lot of people" Whiteley said. "I hate to think what would have happened if it had gone right over the 'Two Guys from Harrison' store over on 206. And it just missed there.

"The whole thing lasted just about a minute. The funnel was moving at about 50 miles an hour. Its path varied in width from 100 to 200 yards and it was just over a mile long.

Funnel Rises and Falls

"It moved from the other (west) side of Route 206, across 206. Then it went along the Groveville Road, across Route 130 and into Groveville. It wasn't on the ground all the way; the funnel rose and fell as it moved along."

It was a freak storm, said Whiteley, but not unheard of in this general area.

(*Trenton Times*)

A Selective Bibliography in Meteorology

This book list in meteorology was prepared by Mrs. Evro Layton of the American Meteorological Society headquarters. The first installment appeared in the June issue. Some out-of-print books have been included, due to their importance, since they may be found in many libraries. New titles will be listed in *Weatherwise* periodically.

CLIMATOLOGY: Ahlmann, H. W., *Glacier Variations and Climatic Fluctuations.* New York, American Geographical Society, 1953. 51 p. $3.50. Bowman Memorial Lectures, ser. 3. Past and current glacial trends with emphasis on recent climatic changes.

Air Ministry, Meteorological Office, *Tables of Temperature, Relative Humidity, and Precipitation for the World,* six parts. London, Her Majesty's Stationery Office, 1958. Composite tables show averages and extremes for each month of year for a large number of weather stations in all parts of the inhabited world.

Aronin, Jeffrey E., *Climate and Architecture; progressive architecture book.* New York, Reinhold, 1953. 304 p. $12.50. Discusses various types of climate-adapted architecture. How the weather elements influence building design and community planning.

Bates, D. R. ed., *The Earth and Its Atmosphere.* New York, Pergamon, 1958. 324 p. $6.00. Fifteen scientists present background material for students of the IGY.

Baver, Leonard D., *Soil Physics.* New York, John Wiley, 1956. 489 p. $7.75. Meteorological factors affecting soil structure, moisture, productivity, and erosion.

Blair, T. A., *Climatology, General and Regional.* New York, Prentice-Hall, 1942. 484 p. $6.95. An intermediate text book.

Brooks, C. E. P., *Climate Through the Ages.* A study of the historical climatic factors and their variations. Rev. ed. New York, McGraw-Hill, 1949. 395 p. $3.00. Out of print.

Brooks, C. E. P., *Climate in Everyday Life.* New York, Philosophical Society Library, 1951. 314 p. $4.75. A discussion of the climate factors which affect our daily lives and businesses.

Clayton, Henry H., *World Weather Records.* Smithsonian Institution, 1927. 1199 p. Vol. 1 covers the period from earliest records to 1920. Vol. 2 from 1921–1930. (1944). Vol. 3 from 1931–1940. (1947). Monthly temperature and precipitation data for every year of record at a number of selected world locations.

Franklin, T. B., *Climates in Miniature: A Study of Micro-climate and Environment.* New York, Philosophical Library, 1955. 137 p. $3.75. Popularized study of weather effects on gardens and fields by a devoted nature lover.

Geiger, Rudolf, *The Climate Near the Ground.* Cambridge, Mass., Harvard University Press, 1957. 494 p. $6.00. Revised edition. A comprehensive survey of micrometeorological problems. Valuable both for the researcher and the general reader. Includes revised bibliography.

Haurwitz, Bernhard, and James M. Austin, *Climatology*. New York, McGraw-Hill, 1944. 410 p. $8.00. A college text. Approach is from the dynamical climatology viewpoint with much emphasis on air masses and moving disturbances.

Huntington, Ellsworth, *Civilization and Climate*. New Haven, Yale University Press, 1933. 333 p. $5.50. A study of climate factors in the rise and decline of various civilizations.

Kendrew, W. G., *The Climates of the Continents*. 4th ed. New York, Oxford University Press, 1953. 607 p. $8.80. A standard descriptive text of the main features of world climate.

Kendrew, W. G., *Climatology; treated mainly in relation to distribution in time and place*. 2d ed. New York, Oxford University Press, 1957. 416 p. $6.75.

Markham, S., *Climate and the Energy of Nations*. London, Oxford 1944. 236 p. $3.50. Out of print. Traces historic movement of civilization centers. Three last chapters deal with America.

Shapley, Harlow, ed., *Climatic Change: Evidence, Causes, and Effects*. Cambridge, Mass., Harvard University Press, 1954. 318 p. $6.00. A series of articles by authorities who consider climate change in relation to physical and biological factors.

Thomas, Morley K., *Climatological Atlas of Canada*. Ottawa, National Research Council, 1953. 253 p. 84 maps. $2.00. Data on average distribution and extremes of temperature, humidity, wind, snowfall, rainfall, and sunshine. Of special value to designers and building engineers.

Trewartha, Glenn T., *Introduction to Weather and Climate*. New York, McGraw-Hill, 1954. 402 p. $7.75. A text which emphasizes both the systematic aspects of the subject and the regional features as revealed in world weather patterns.

U. S. Navy, *Marine Climatic Atlas of the World*. Washington, Government Printing Office, 1955–57. Vol. 1. North Atlantic Ocean. 275 p. $8.00. Vol. 2. North Pacific Ocean. 275 p. $8.00. Average conditions over oceanic areas. Other volumes in preparation.

Visher, S. S., *Climatic Atlas of the United States*. Cambridge, Mass., Harvard University Press, 1954. 403 p. $9.00. A series of 1,031 maps of rather small format which depict the distribution of the weather elements by month, season, and year.

PERIODICALS: UNITED STATES

Bulletin of the American Meteorological Society. Monthly. AMS, 3 Joy St., Boston 8, Mass. $12.00 to non-members.

Journal of Meteorology. Bimonthly. AMS, 3 Joy St., Boston 8, Mass. $12.00 to non-members.

The Mariner's Weather Log. Bimonthly. U. S. Weather Bureau. Superintendent of Documents, Gov't Printing Office, Wash. 25, D. C. $1.00.

Meteorological Abstracts and Bibliography. Monthly. AMS, 3 Joy St., Boston 8, Mass. $8.00.

Meteorological Monographs. Irregular. AMS. Price varies.

Monthly Weather Review. Monthly. U. S. Weather Bureau. Superintendent of Documents, Gov't Printing Office, Wash. 25, D. C. $4.00.

Transactions of the American Geophysical Union. Bimonthly. National Research Council, Amer. Geophys. Union, 1515 Massachusetts Ave., Washington 25, D. C. $9.00.

Weatherwise. Bimonthly. AMS, 3 Joy St., Boston 8, Mass. $4.00.

GREAT BRITAIN

The Marine Observer: a quarterly journal of maritime meteorology. British Met. Office. Her Majesty's Stationery Office, York House, Kingsway, London, W.C. 2, England. $3.65.

Meteorological Magazine. Monthly. British Met. Office. Her Majesty's Stationery Office. $4.50.

Quarterly Journal of the Royal Meteorological Society. RMS, 49 Cromwell Road, London S.W. 4, England. $12.00.

Weather. Monthly. RMS, 49 Cromwell Road, London S.W. 4, England. $3.35.

OTHERS (mainly English text)

Australian Meteorological Magazine. Canberra. Quarterly.

Bulletin of the World Meteorological Organization. Quarterly. WMO, Geneva, Switzerland. $1.00.

Geophysical Magazine. Irregular. Central Met. Observatory. Tokyo, Japan.

Indian Journal of Meteorology and Geophysics. Quarterly. Indian Met. Dept. Manager of Publications, Delhi, India.

Notos. South African Weather Bureau. Pretoria. Quarterly. $4.90.

Tellus: a quarterly journal in geophysics. Swedish Geophysical Society. Lindhagensgatan 124, Stockholm. $7.85 with postage.

U. S. WEATHER BUREAU (Climatological)

Average monthly weather resume and outlook. Semi-monthly. Presents in graphic form the observed temperature and precipitation departures from normal for the past month and experimental monthly outlook covering expected temperature and precipitation. Cat. No. C30.46. $4.80 per year.

Climatological Data for the United States by sections. Monthly with annual summaries. Contains weather statistics from 47 separate sections. (Indicate desired section when ordering.) One section $2.50 per year. All sections $48.00 per year. Cat. No. C30.18.

Climatological Data. National Summary. Monthly. Contains condensed data for 1st order stations and summary of severe storm reports. $4.00 per year with annual summary. Cat. No. C30.51.

Daily Weather Map. Daily weather map, Washington forecasts, and occasional feature articles. $7.20 per year. Cat. No. C30.12.

Local Climatological Data. Monthly. Daily and monthly observational data for each of about 270 stations. Specify city desired. Price per city $1.50 per year. Cat. No. C30.56.

Monthly Climatic Data for the World. Monthly. Contains surface pressure, temperature, humidity, precipitation as well as upper-air temperature and dew point for selected world cities. $2.75 per year. Cat. No. C30.50.

Weekly Weather and Crop Bulletin. National Summary. Synopsis of weekly climate conditions and their effects on crops and farming. Also contains *Snow and Ice Bulletin* in winter. $3.00 per year. Cat. No. C30.11.

U. S. WEATHER BUREAU PUBLICATIONS

Aneroid Barometer. How to read and set a barometer. (1957). 10 p. 15¢. Cat. No. C30.2: B 26/2.

Aviation Series. Set of pamphlets: 1–18 inclusive. Aimed at helping pilots to apply weather knowledge to practical flight problems. (1957). Complete set 75¢. Cat. No. C30.65:1–18.

Directory of Weather Broadcasts. Schedule of weather broadcasts from Weather Bureau offices over standard AM-FM stations. (1957). 25¢. Cat. No. C30.73:957.

Instructions for Climatological Observers. 10th ed. Methods of taking rainfall, temperature, etc. observations, and descriptions of instruments. (1955). 55¢. Cat. No. C30.4:B/955.

Manual of cloud forms and codes for states of the sky. Definitions and descriptions of the forms of clouds with 47 illustrations. (1956). 30¢. Cat. No. C30.4:S/956.

Manual of marine meteorological observations. Instructions for taking observations at sea. (1954). $1.25. Cat. No. C30.4:M/956 1 & 2.

Manual of surface observations. 7th ed. Instructions for taking and encoding observations for transmission. (1957). $1.25. Cat. No. C30.4:N/957.

Pilot's weather handbook. Basic information to enable a pilot to profit by weather forecasts. CAA. (1955). $1.50. Cat. No. C31.138:104.

Practical methods of weather analysis and prognoses. Discusses the generally accepted methods of forecasting from current map data. Naval Weather Service. (1955). $2.00. Cat. No. D202.6:v37.

Principal tracks and mean frequencies of cyclones and anticyclones in the Northern Hemisphere. Detailed history of cyclone and anticyclone track charts, etc. by William Klein. (1956). $1.00. Cat. No. C30.29:40.

The Thunderstorm, report of the Thunderstorm Project, etc. A team of scientists subjected the thunderstorm to critical scrutiny. (1949, 1950). $2.25. Cat. No. C30.2:T 42/2.

JUVENILE: Barr, Jene, *Dan the Weatherman.* Chicago, Albert Whitman and Co., 1958. 30 p. $1.25. Grades 1–4. Explains how the weatherman determines the forecast. Illustrations by a TV weatherman.

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Spilhaus, Athelstan F., *Weathercraft.* New York, Viking Press, 1951. 64 p. $2.00. Grades 5–9. How to build a simple backyard weather station from readily available materials.

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Wilson, V., and J. Berke, *Watch out for the Weather.* New York, Viking, 1951. 226 p. $2.95. Mental and physiological effects emphasized—good for high school age.

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Letters to Editor

Sir: During the annual meeting of the Western Snow Conference at Bo_eman earlier this week our mutual acquaintance Arnold Court, asked that I verify the location of the former Riverside Ranger Station near West Yellowstone, Montana. An examination of the southern end of the Madison County township and section transportation map reveals that Riverside Ranger Station was located from one-half to one mile west of the Wyoming-Montana boundary for about nine years prior to the observing of the 66 below zero reading in February 1933. That reading then was observed within Montana boundaries, but of course has since been supplanted by a 70 below observation at Rogers Pass in January 1954. These conclusions are based upon notations in the West Yellowstone and Riverside Station history files which indicate that the present ranger station location on the eastern edge of the town of West Yellowstone was 1½ miles east of the Riverside Ranger Station site. This location of course is within Yellowstone National Park but also within Montana.

Through some quirk of early Weather Bureau Records Management, records for Yellowstone National Park were published for a good many years in Wyoming Climatological Data, whether or not they were within Montana or Wyoming sections of the Park. It has been only within the last ten years that the Montana sections of Yellowstone National Park have been handled by the Montana Section Center or State Climatologist Office.

R. A. DIGHTMAN,
State Climatologist,
Helena, Montana

WORLD RECORD MINIMUM

A dispatch from M. J. Rubin, U.S.-IGY observer at Mirny in Antarctica, indicates that a new world record for surface minimum temperature was reached at Sovetskaya (78°24′S. 87°35′E.) on 25 June 1958 at 2200 GMT with a reading of − 117.4° F.

Upper Air (*Continued from page 125*)

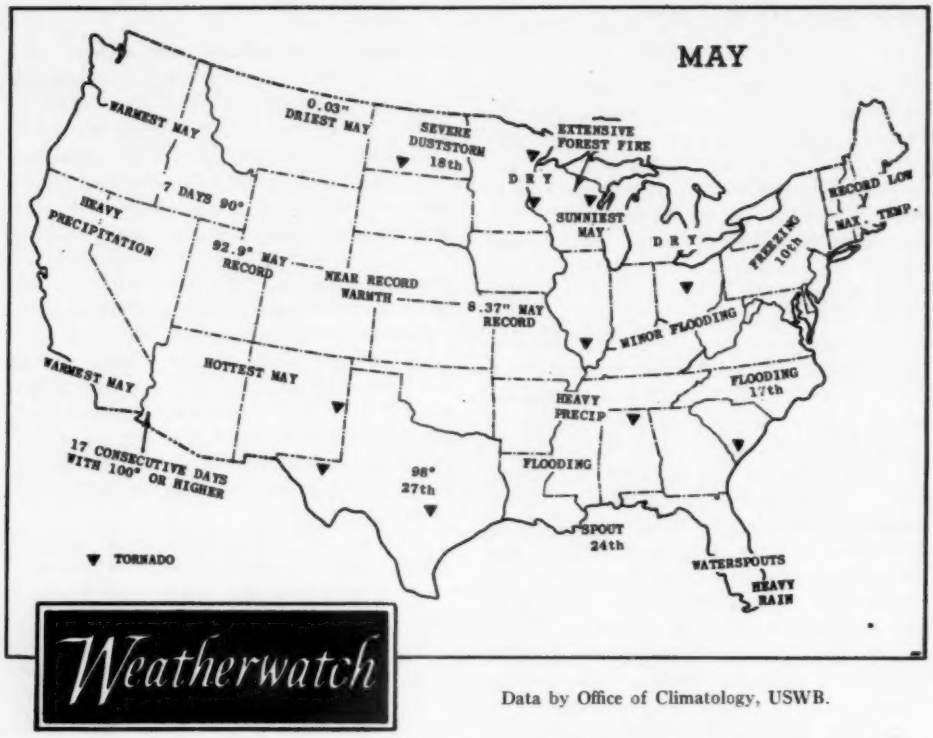
Bureau is used aboard the other vessels. Receiving equipment for the 72.2-Mc. radiosonde is being transistorized, with receiver, frequency meter, and recorder being housed in a small valise-size case that can be easily carried in one hand. With small, compact equipment and collapsible, portable inflation shelters, establishment of an upper-air program aboard ship becomes a simple problem, requiring the installation of the shelter and the helium cylinder racks, and rigging an antenna.

Quality and accuracy of upper-air data from transient ships has been high. Using 300-gram balloons, the average ascent has reached over 16,900 meters or approximately the 90 millibar surface. Eight of these programs are now in operation, five in the Pacific, two in the Atlantic, and one in the Gulf of Mexico.

Determining winds aloft from transient ships remains a major problem. There is no low-cost electronic equipment now available that can be used aboard merchant ships.

An important item in any observational program is the cost. In the upper-air program involving Military Sea Transport Service vessels, the Navy Department provides the ground equipment and flight expendables and the Weather Bureau provides the observers. Cost of the program involving merchant ships is borne entirely by the Weather Bureau and is approximately $40,000 per year for each vessel in operation. Two observers are assigned each voyage and work an average of 9 hours a day, 7 days a week, while the ship is at sea. Ore carriers and tankers will be at sea almost 90 per cent of the time while freighters may average about 70 per cent.

Experience gained from the programs aboard tankers, freighters, ore carriers, passenger ships, and oceanographic research vessels indicates that such radiosonde programs can be conducted on practically any type of vessel. The data supplied by the transient-ship radiosonde program have been of considerable value in obtaining upper-air data over vast areas where such data are not otherwise obtainable. This has aided in the development of numerical weather prediction techniques, and materially assisted forecasting and analysis in the Pacific, Gulf, and Atlantic areas.



Data by Office of Climatology, USWB.

Placid May—Turbulent June

DAVID M. LUDLUM, *Editor*

It is a pleasure to discuss a month such as May 1958 during which the meteorological scales were very definitely balanced on the favorable side for man and his endeavors. There were no major weather-induced disasters in the United States. In fact, reports from the field were a joy to scan:

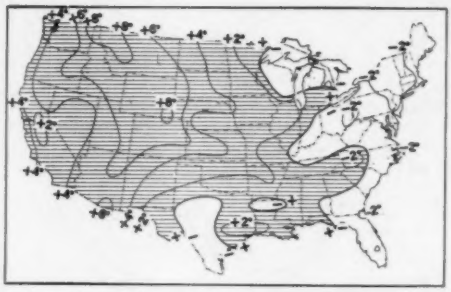
Cleveland: pleasant weather.
Columbus: no wind storms.
Raleigh: temperature exactly normal.
Evansville: typical May weather.
Richmond: crop growth phenomenal.
Abilene: beautiful weather—temperature normal, ample rainfall.
Amarillo: very pleasant month.
Wichita: excellent crop progress.
Reno: adequate water.
Los Angeles: every day above normal.

In searching for interesting and unusual features to play-up, your editor had to search rather hard through his charts, maps, and summaries to discover noteworthy events. On the unfavorable side of the balance, though, the following conditions came to light:

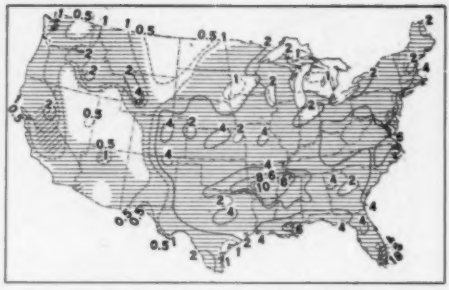
(1) Recurrent frost in the Northeast and Lakes region with a tendency for low daily maxima which held back vegetation.
(2) Drought from Montana eastward along the border to lower Michigan though this was relieved at many places on the final two days.
(3) Excessive warmth over the western half of the country, especially after the 15th, with record or near-record monthly averages.

The lack of serious tornadoes in the usual spring twister belt of the Midwest made the month outstanding in this category. Severe wind storms, too, were few, as was thunderstorm activity. There were some reports of hail at scattered localities, but the frequency and damage was far below anticipated norms. Flooding, also, was relatively unimportant except for the overflow of coastal streams in eastern North Carolina, unusually high water along the Ohio in mid-month, and some minor flooding in the Columbia system of the Northwest when snow melt accelerated under high temperatures.

MAY CIRCULATION—The pressure topography of the May upper-air charts reveals a large ridge of high pressure stretching from Mexico to the Arctic Ocean as the principal continental feature. The ridge increased in stature as the month progressed and dominated all air flow over North America after May 15th. The charts showing departure from normal pressure also reveal above normal figures over



Departure of Average Temperature from normal in degrees Fahrenheit. USWB chart.



Total Precipitation in inches. USWB chart.

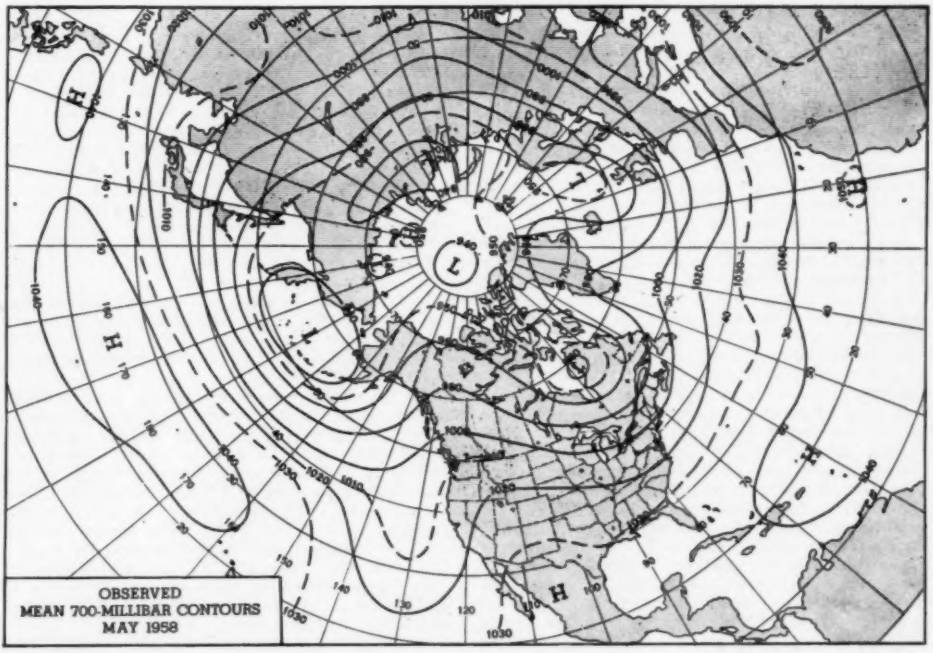
central portions of the United States with a tendency to drop to normal departures or just below normal as the Atlantic and Pacific Coasts are approached. Off the Pacific Coast a trough with rather marked contours existed about 700 miles west of California, while downstream from the ridge over western North America a major trough took form, extending all the way from a center in western Quebec, across the Middle Atlantic states, and south to a sub-center over Cuba.

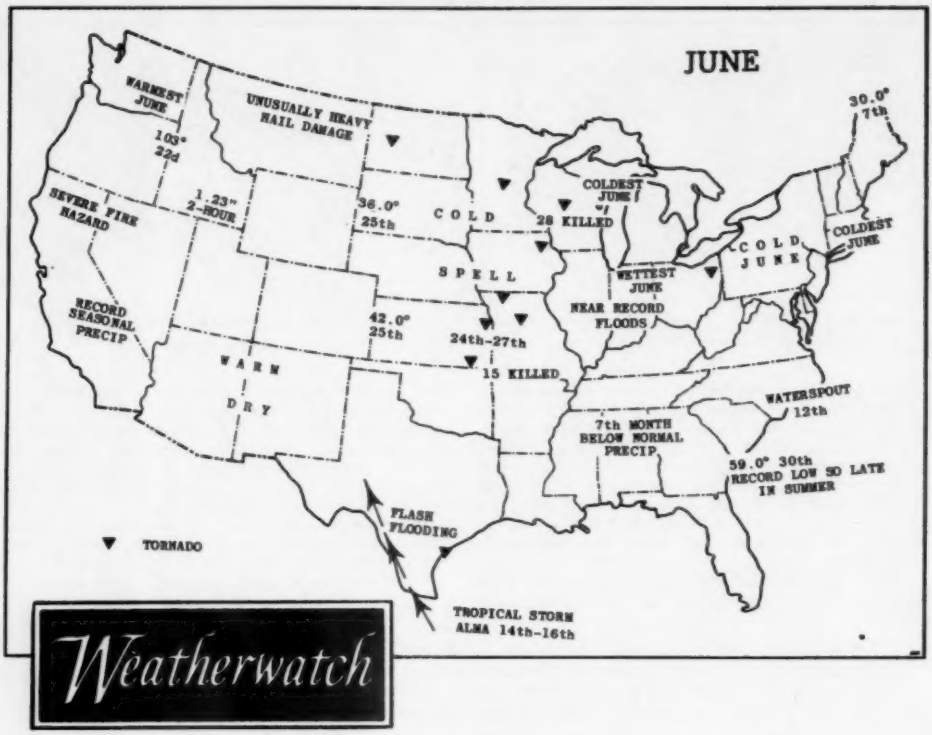
The combination of a strong and increasing ridge over the West and an intense and deepening trough over the East produced an outflow of continental air which resembled winter monsoon conditions. Tropical air from the Gulf of Mexico could not force its way northward with any consistency during the month. Thus, with infrequent air mass contrast, the occurrence of turbulent weather associated with frontal conflicts was unusually low.

Two oceanic features were of prime importance also in determining the May weather pattern over the United States. The trough with steep contours off the California coast created a pressure valley

(*Continued on page 144*)

The upper-air map below shows the pattern of air flow for May at about 10,000 feet, on which the average weather largely depends. The contours lines represent the mean height of the 700 mb. pressure level. Figures are in tens of feet: 1020 = 10,200 ft., 980 = 9,800 ft., etc. Chart by Extended Forecast Section, USWB.





Weatherwatch

The relatively placid meteorological conditions which had characterized the month of May gave way to a stormy and turbulent period with the advent of June. In fact, the cold front which moved across the Upper Mississippi Valley on the 31st signaled the end of the reign of stability in atmospheric conditions—it broke up an incipient drought along the northern border and induced a series of squall lines and cold fronts which were accompanied by violent thunderstorms of the cloudburst type, destructive hail storms, and death-dealing tornadoes.

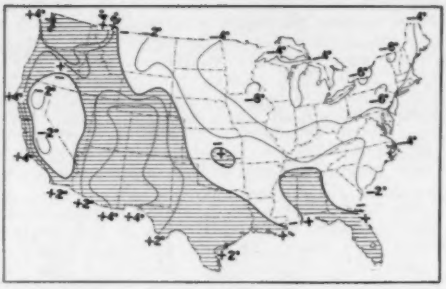
A superficial glance at the circulation maps of the two months would indicate a similarity of the pressure patterns. The deep low over eastern Canada in May moved only a short distance westward to Hudson Bay; the ridge over western Canada and the Plateau states continued to enforce a strong blocking effect; and the trough off the California coast remained to supply a warm southerly flow over the persistently warm Pacific and Plateau states.

A closer study of the contours and a consideration of the developing trends during June reveal the gradual disintegration of the strong blocking anticyclone in the mid-Atlantic, the prominent feature of all the May charts which had shunted all eastward-moving lows northward into the Arctic. The Atlantic anticyclone separated into two parts by mid-June: the northern sector built up over central Greenland, while the southern portion merged with the semi-permanent tropical high pressure cell. Through the center of this erstwhile block a west-east trough stretched from Labrador to the British Isles. Thus, as June progressed, the way became open for North American depressions to sweep eastward across the Atlantic on a normal seasonal track.

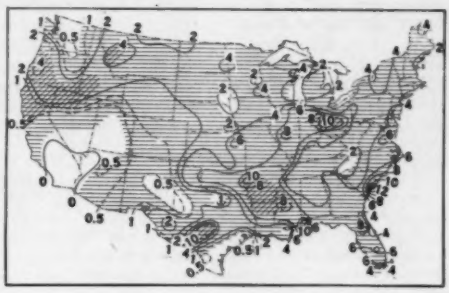
The key to the circulation picture for June lies in the great excess of pressure over the Arctic regions of the Western Hemisphere. The mean sea level map reveals three major centers of excess pressure: Greenland had + 6 mb. (0.18″), northwestern Canada + 7 mb. (0.21″), and the Gulf of Alaska just west of British Columbia + 6 mb. A long finger of high pressure extended southeastward from northwestern Canada into the northern Plains states to provide an easy channel for cold air masses to pour into the United States where pressure was everywhere below normal figures. The greatest departures were noted over Colorado and the middle Ohio Valley. Pressure was also below normal in Mexico and in the Atlantic Ocean east of the West Indies, all of which encouraged a movement of air from polar regions to the Tropics.

An important feature among the June developments was the building inland of the Atlantic tropical anticyclone, a customary seasonal migration which always spells the summer season. The upper-air charts at middle levels showed pressure as just normal along the Gulf of Mexico coast of the United States, while 1,400 miles to the north in Ontario pressure readings were much below normal, indicating a very marked pressure gradient over the Eastern United States. Since such a pressure difference induces strong winds, the upper-air flow from west to east between these two pressure features was much faster than normal.

A like pressure situation with an equally tight



Departure of Average Temperature from normal in degrees Fahrenheit. USWB chart.



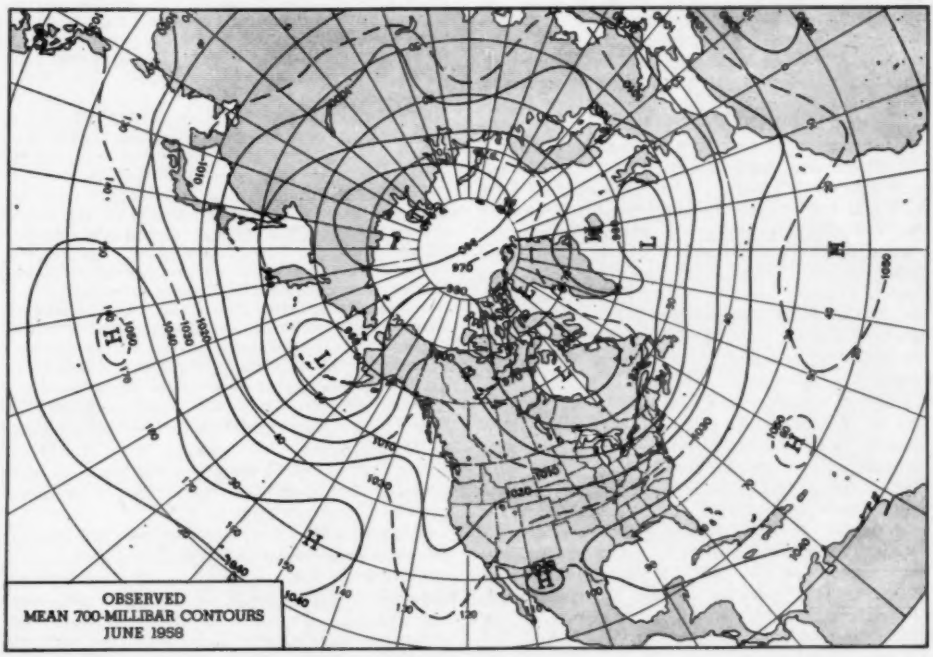
Total Precipitation in inches. USWB chart.

gradient existed to the westward of the Ontario low center. Pressure was about normal along the border of Montana and South Dakota, but there was a great excess just west of British Columbia. Here again there was fast wind movement between the two pressure features, this time coming from the Northwest out of the Arctic and down across the Great Lakes into the Northeast.

The pattern of cyclonic movement was typical of an early summer month with no low centers crossing the Pacific coastline, and no cyclonic activity in the Southern states aside from two minor disturbances which formed along stationary fronts over South Carolina on the 16–17th and 21–22nd. The Hudson Bay region proved a magnet for lows. The resulting cyclonic circulation over eastern Canada brought impulse after impulse of cold air into the United States.

The charts of anticyclonic movement also follow the prevailing air flow. Strong highs moved southeastward from the Canadian Arctic to pass either over or near the Great Lakes. One important high, an exception to the above trend, built up over the central Plains on the 25–26th and played an important role in bringing record-breaking June minima to the southern Plains and the Southland in general.

COLD JUNE—Cold air invaded the Great Lakes region and the Northeastern states repeatedly during the first half of June to set many new date and so-late-in-the-season minimum records. At Albany the Weather Bureau declared it the coldest month of June since the famous 1816, "the year without a summer." The cold air invaded the Southland, too, after the 15th with the major penetration coming on



the 25–27th when many stations in the southern Plains and Gulf region registered their coldest ever for so late in the season.

At Green Bay, Wisconsin, June was the coldest ever by a substantial margin—with records dating back to 1886, it averaged colder by 1.3° than any previous June. New date minimum marks were set on 9 days, and the first 32° reading ever registered in June occurred on the 6th. At Escanaba, Michigan, there were frosts on the 6, 9, 11, and 14th, all but that of the 11th being heavy. Further inland from the lakes a reading of 28° was reported at Danbury, Wisconsin, a traditional cold spot. At Sault Ste. Marie the mercury tumbled to 33° on the 6th (a new record) and to 35° on the 9th when a heavy frost occurred. The highest for the month there was only 78°.

Further east June 7th was the cold morning with the mercury dipping below freezing in the interior highlands from West Virginia to Maine (28° at Phillipsburg, Pa. and 30° at Caribou, Maine). Concord, New Hampshire, had 33° that morning and the latest killing frost of modern record. Other low readings at major stations were: Burlington, Vermont, 35°; Albany, New York, 37°; and Hartford, Conn., 38°.

It is interesting to note the coincidence of the June 7th, 1958 freeze in interior New England with the famous cold of June 7, 1816, generally the coldest morning of that summer. Naturally, the question arises as to how June 1958 compares with the 1816. The following are the facts as we have them.

The initial cold front of June 1816 moved across New England and New York State on the afternoon of the 5th, dropping readings from the low 90's to the 40's by morning. At sunrise on the 7th the mercury slumped to 30.5° at Williamstown, Mass., to 30° at Brunswick, Maine, and to 35° on the Yale campus at New Haven. At Waltham, Mass., nine miles west of Boston Common, a reading of 35° on the morning of the 7th was noted on a reliable thermometer (northern exposure on a porch) and a mark of 33° followed on the morning of the 10th. Thus, it would appear that current June figures in New England were at least three to four degrees higher than in 1816, and the cold period in the latter year extended over many more days with readings in the 30's on five consecutive mornings. But to balance the record it should be pointed out that June 1816 also had its very warm days—in addition to the 90.5° on the 5th at Waltham, the mercury spurted to 93.5°, 99°, and 98° on the 22, 23, and 24th of 1816. The mercury this June at Boston Airport exceeded the 80° mark only six times with the maximum of 89° coming on the 30th! Of course, it was the snowfall of June 1816 which made the indelible impression on the minds of contemporaries.

The Plains states from Dakota southward to Texas and the Southern states eastward to Georgia experienced a record-breaking cold spell from the 25th through the end of the month. From the Black Hills of South Dakota to Texas, new daily minima records were set and also new so-late-in-the-season cold marks. At Dallas records were equaled on the 25th and exceeded on the 26, 27, and 28th, the lowest being 60° on the 26th. Mobile, Alabama had new low records on the 28 and 29th; Savannah, Georgia, marked 59° in the record books on the 30th for a new late season reading.

May (*Continued from page 141*)

whose cyclonic circulation brought a southerly flow of warm, stable air to the Pacific Coast and Plateau states—hence the persistent warm conditions everywhere in the West. A block of impressive size for May developed a barrier in the mid-Atlantic Ocean south of Greenland which forced eastward-moving lows of the Alberta type to turn northward after crossing the Great Lakes and also channeled East Coast cyclonic activity directly northward to the low center over Quebec.

The westerly flow index varied throughout the month, though it averaged above normal for the month as a whole, the first such month since December 1957. In fact, May exhibited a great reversal from the four-month period of below-normal westerly flow, a period during which many spectacular weather events occurred. The position of the jet stream perhaps best illustrates the change which took place early in May as the long index cycle came to an end. In April the principal westerly jet was found over the Gulf States, while in May the maximum wind speeds at the 10,000 ft. level were over the Great Lakes, a change of about 550 miles.

From the low levels at the end of April the westerly index increased during the first days of May and averaged well above normal from the 8th through 15th as high pressure occupied Canada and several lows moved across the Southern states. As the Hudson Bay low center reasserted its dominance after the 15th, the index dropped gradually to reach a low figure for the month during the passage of a tropical storm off the East Coast on the 24–26th.

Anticyclonic activity was above normal for May in the United States as six marked centers moved southeastward out of the strong ridge over western Canada. Three centers passed eastward over New England and three more moved farther south to reach the coastline in the vicinity of the Virginia Capes. Each anticyclonic visitation brought an outbreak of cold air to the Great Lakes and Northeast to account for the persistently below normal temperatures there throughout the month.

TROPICS-TO-ARCTIC STORM—A storm center formed in the western Caribbean off the Yucatan Peninsula on 22 May near 17° N. During the morning of the 24th it crossed extreme western Cuba, passed through the Florida Straits along the course of the Gulf Stream, and headed northward passing between Palm Beach and Grand Bahama Island.

The easterly circulation which preceded the northward-moving low initiated torrential tropical downpours along the extreme southeast coast of Florida. Downtown Miami measured 4.17″ on the 23rd and 5.01″ on the 24th—over an inch fell during the lunch hour from 1200 to 1300 on the 24th! These totals boosted the May figure at Miami to the second highest May figures since records commenced in 1911. The total for May 1958 reached 16.15″, as compared to 18.66″ in May 1925—normal is 4.27″. Winds during the passage of the low center some 60 miles eastward reached only 31 mph. from the northeast, and the pressure dropped to 29.69″.

A trough along the New England and Middle-Atlantic coasts on the 25th offered a congenial track northward for the low center which soon gathered more energy and deepened as it reached extra-tropical latitudes. Early on the 26th the center was about 250 miles east of Cape Hatteras; with the

heavy rain shield just reaching that point, 3.28″ fell in a 24-hour period on the 26th. Wilmington, North Carolina, a bit farther west, received a fall of 1.44″.

The rain area extended northward to coastal Maryland, but then skipped eastward, missing New Jersey and Long Island, but hitting Nantucket Island where almost an inch fell on the 27–28th when the center was still 200 miles to the east. From this point the center was bucking the mid-Atlantic blocking high and was shunted directly northward along the 65° W. meridian. The center made a landfall on Nova Scotia, then passed over western Laborador with pressure now down to 987 mb (29.15″), and finally bisected Baffin Land. The storm was last identified on June 1st near Thule only 700 miles from the North Pole. In ten days it had made it all the way from south of the Tropic of Cancer to well north of the Arctic Circle.

MIDWEST COLD FRONT STORM—A small wave formed on the polar front close to the border of Montana and Saskatchewan on May 29th where maritime Pacific air and continental polar air came into conflict. To the southeast lay modified polar air which had made a long swing around a large anticyclone. Despite the lack of potentially active tropical air in advance, this small wave, with a south-southwestward trailing front, developed remarkable energy as it pushed across the upper Mississippi Valley late on the 30th and 31st. As afternoon thunderstorms developed on the 31st, it soon became a good rain producer and soaked an area which had been approaching serious drought conditions.

The cold front stood on the Bismarck-Pierre-Valentine line at 0100 on the 31st. Racing southeastward at 45 mph. the front was on the Chicago-St. Louis line twenty-four hours later. Heavy showers and thundershowers broke out in advance of the front as it crossed the farm areas west of the Mississippi River. Des Moines, Iowa, had 2.04″ and following winds of 56 mph. In Illinois, Moline reported 2.13″ and Peoria 3.17″ late on the 31st. The precipitation in southern Minnesota and Wisconsin was the first appreciable fall of the month and helped to allay the serious water shortage there. Milwaukee had just experienced its driest first 29 days in May of record. This series of showers initiated a period of cloudbursts in the Midwest which would make June a notable flood-producer in the area.

The center of the disturbance was over Chicago at 0100 on June 1st. From there the center speed 900 miles to Caribou, Maine, in another twenty-four hours; the front then lay on the Burlington-Utica-Huntington-Nashville line. Moderate to heavy rains fell through the Lower Lakes and Ohio Valley. By noon of 2 June the front had reached the Atlantic Coast from Eastport to Norfolk. A strong following high appeared over Quebec with a central pressure of 1032 (30.48″) and pushed a cool air mass into the Northeast which set numerous date minimum records.

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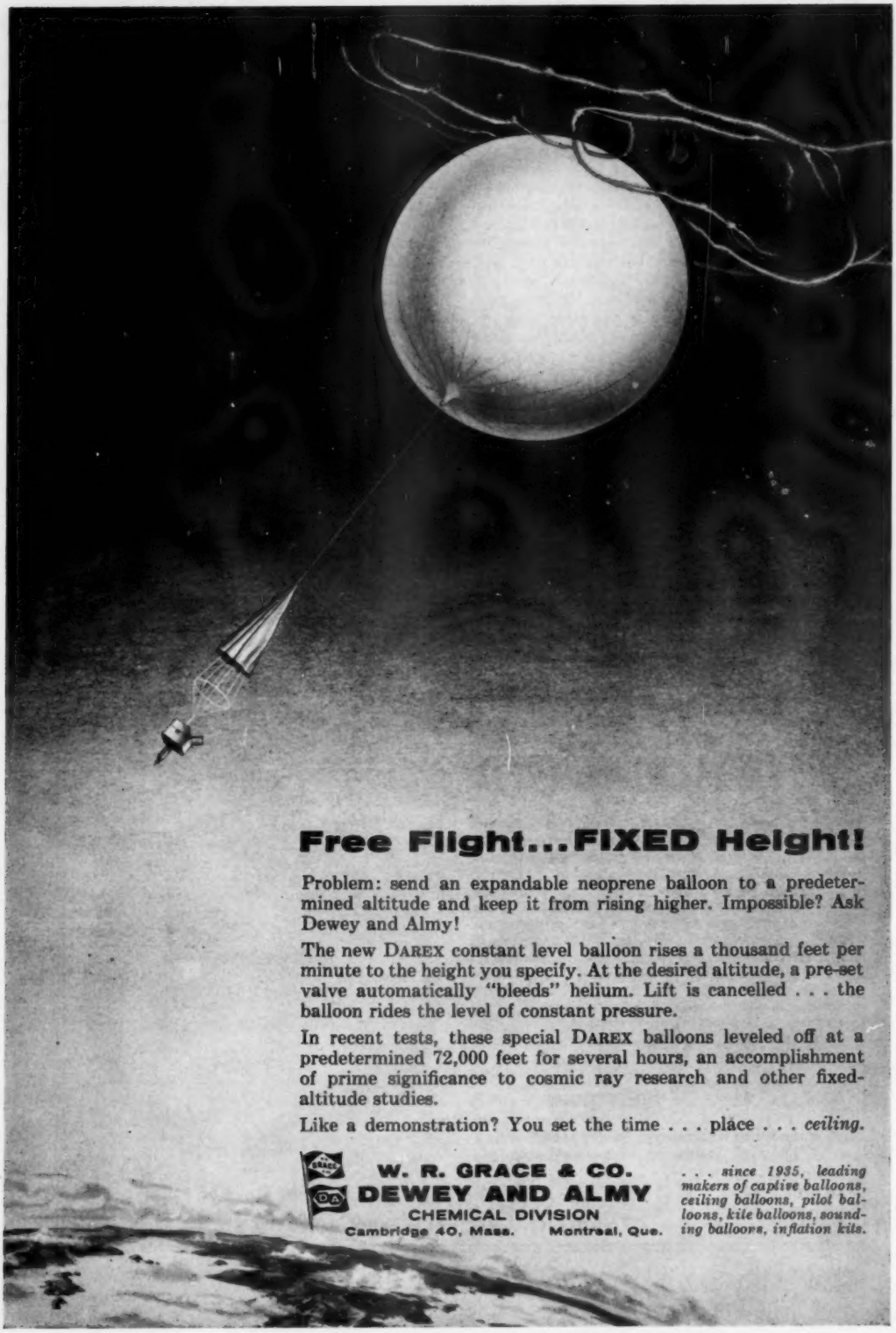

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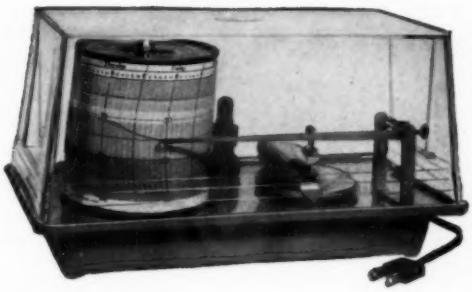

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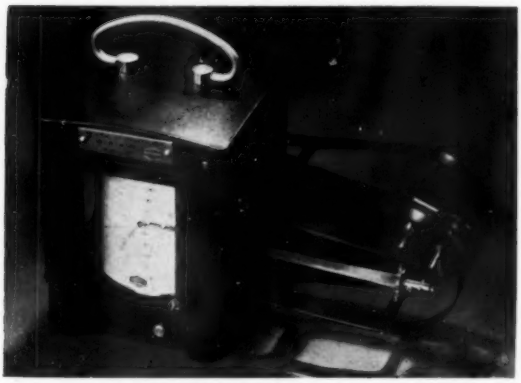

No. 156. Thermograph

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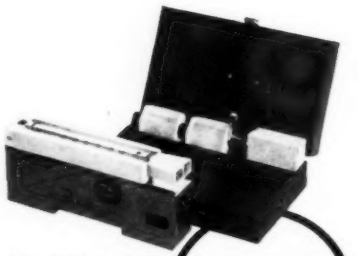

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